WELDING APPLICATIONS

COURSE DESCRIPTION

***Welding Applications** is a course designed to follow *Principles of Welding,* in which students will learn more advanced techniques and skills related to cutting and welding applications, particularly as they relate to stainless steel and aluminum. Welding and cutting skills will be developed in the context of a series of projects. Following the completion of this course, the student should be prepared for Entry Level Welding Certification, as defined by American Welding Society QC10.**

Prerequisite(s):	Principles of Welding; Algebra I or Math for Technology II; Geometry (may be concurrent)
Recommended:	Engineering Design/CAD (may be concurrent)
Recommended Credits:	2
Recommended Grade Level(s):	11th or 12th

***This course may be offered as a part of the Construction or the Manufacturing Sub-Clusters, depending upon the student's career focus. (Construction Core is required for students in the Construction Sub-Cluster, but it is not required for students in the Manufacturing Sub-Cluster if their instructors hold AWS certification.)**

WELDING APPLICATIONS STANDARDS

1.0 Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

2.0 Students will interpret, layout, and fabricate in conformance to construction and fabrication drawings.

3.0 Students will perform air carbon arc gouging operations on plain carbon steel.

4.0 Students will make single- and multi-pass fillet and groove welds on plain carbon steel in all positions using a Flux-Cored Arc Welding (FCAW) process.

5.0 Students will make fillet and groove welds on plain carbon steel in all positions using a short-circuit, spray transfer, or pulsed-arc Gas Metal Arc Welding (GMAW) process.

6.0 Students will perform plasma arc cutting operations on carbon steel, stainless steel, and aluminum.

7.0 Students will make fillet and groove welds on carbon steel, stainless steel, and aluminum in all positions using a Gas Tungsten Arc Welding (GTAW) process.

WELDING APPLICATIONS

STANDARD 1.0

Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

LEARNING EXPECTATIONS

The student will:

1.1 Exhibit positive leadership skills.
1.2 Participate in SkillsUSA-VICA as an integral part of classroom instruction.
1.3 Assess situations and apply problem-solving and decision-making skills to particular client relations in the community, and workplace.
1.4 Demonstrate the ability to work cooperatively with others in a professional setting.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

1.1.A Demonstrates character, leadership, and integrity using creative and critical-thinking.
1.2.A Applies the points of the creed to personal and professional situations.
1.2.B Participates and conducts meetings and other business according to accepted rules of parliamentary procedure.
1.3.A Analyzes situations in the workplace and uses problem-solving techniques to solve the problem.
1.4.A Participates in a community service project.
1.4.B Assists with an officer campaign with Tennessee SkillsUSA-VICA.

SAMPLE PERFORMANCE TASKS

- Create a leadership inventory and use it to conduct a personal assessment.
- Participate in various SkillsUSA-VICA programs and/or competitive events.
- Evaluate an activity within the school, community, and/or workplace and project effects of the project.
- Implement an annual program of work.
- Prepare a meeting agenda for a SkillsUSA-VICA monthly meeting.
- Attend a professional organization meeting.
- Participate in the American Spirit Award competition with SkillsUSA-VICA.

INTEGRATION LINKAGES

SkillsUSA-VICA, *Professional Development Program,* SkillsUSA-VICA, Communications and Writing Skills, Teambuilding Skills, Research, Language Arts, Sociology, Psychology, Math, Math for Technology, Applied Communications, Social Studies, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, SCANS (Secretary's Commission on Achieving Necessary Skills), Chamber of Commerce, Colleges, Universities, Technology Centers, and Employment Agencies.

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STANDARD 2.0

Students will interpret, layout, and fabricate in conformance to construction and fabrication drawings.

LEARNING EXPECTATIONS

The student will:

2.1 Correctly interpret dimensions and locations of components in construction and fabrication drawings.
2.2 Correctly scale dimensions in construction and fabrication drawings.
2.3 Correctly interpret orthographic views shown in construction and fabrication drawings.
2.4 Recognize and correctly interpret lines and symbols commonly used in construction and fabrication drawings.
2.5 Read and demonstrate understanding of the welding terms and definitions from ANSI/AWS A3.0, *Standard Welding Terms and Definition*.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

2.1.A Makes a material take-off in conformance to construction and fabrication drawings and specifications.
2.1.B Lays out components, structural and others, and their locations to dimensions and tolerances indicated on construction and fabrication drawings.
2.2.A Uses the scale of a drawing to determine locations not explicitly dimensioned.
2.2.B Uses the scale of a drawing to determine dimensions not explicitly shown on drawing.
2.3.A Interprets three-dimensional features found in construction and fabrication drawings.
2.4.A Distinguishes between object lines, dimension and extension lines, center lines, section lines, and other lines commonly found in construction and fabrication drawings.
2.4.B Identifies symbols commonly used in construction and fabrication drawings, including material, electrical, plumbing, HVAC, and plot plan and survey symbols.
2.4.C Interprets welding symbols to determine type, geometry, process, extent, and required testing of welds.
2.5.A Pronounces and uses welding terms in conversation.
2.5.B Uses welding terms in written work.

SAMPLE PERFORMANCE TASKS

- Given shop and assembly drawings for a weldment composed of five to ten components where some components are medium- to high-carbon steel, do a material take-off, including estimates of quantities of filler materials.
- Given shop and assembly drawings for a weldment composed of five to ten components where some components are medium- to high-carbon steel, make a written assembly plan to minimize the possibility of distortion or cracking, and execute the assembly plan.
- Given shop and assembly drawings for a weldment composed of five to ten stainless steel components, make layouts in preparation for all required cutting, and make the required cuts.
- Given shop and assembly drawings for a weldment composed of five to ten aluminum components, make a written assembly plan to minimize the possibility of distortion or cracking, and execute the assembly plan.

INTEGRATION LINKAGES

Language Arts, Mathematics, Math for Technology, Applied Communications, Algebra, Geometry, Blueprint Reading, SkillsUSA Technical Championships, American Welding Society (AWS), Guide for Training and Qualification of Entry Level Welder, National Center for Construction Education Research (NCCER), Secretary's Commission on Achieving Necessary Skills (SCANS), *Professional Development Program*, SkillsUSA-VICA, Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA).

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STANDARD 3.0

Students will perform air carbon arc gouging operations on plain carbon steel.

LEARNING EXPECTATIONS

The student will:

3.1 Perform gouging operations using the air carbon arc cutting process on plain carbon steel.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

3.1.A Removes metal as required by the job assignment using the air carbon arc cutting process on plain carbon steel.

3.1.B Visually examines the resulting surface for conditions meeting the assignment's specifications.

SAMPLE PERFORMANCE TASKS

- Complete a project that incorporates design, fabrication, evaluation, and testing.
- Comply with safety rules and regulations in the handling and operation of welding equipment.

INTEGRATION LINKAGES

Language Arts, Mathematics, Math for Technology, Applied Communications, Algebra, Geometry, Blueprint Reading, SkillsUSA Technical Championships, American Welding Society (AWS), Guide for Training and Qualification of Entry Level Welder, National Center for Construction Education Research (NCCER), Secretary's Commission on Achieving Necessary Skills (SCANS), *Professional Development Program*, SkillsUSA-VICA, Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA).

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STANDARD 4.0

Students will make single-and multiple-pass fillet and groove welds on plain carbon steel in all positions using a Flux-Cored Arc Welding (FCAW) process.

LEARNING EXPECTATIONS

The student will:

4.1 Make single-and multiple-pass fillet and groove welds on plain carbon steel using a FCAW process in all feasible positions.
4.2 Evaluate the distinctive features of FCAW.
4.3 Conduct destructive tests such as guided bend tests and impact tests on samples of FCAW weldments.
4.4 Conduct non-destructive tests such as magnetic particle or dye penetrant on samples of FCAW weldments.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

4.1.A In all feasible positions, makes a single-pass fillet weld on plain carbon steel using a FCAW process.
4.1.B In all feasible positions, makes a multiple-pass fillet weld on plain carbon steel using a FCAW process.
4.1.C In all feasible positions, makes a single-pass groove weld on plain carbon steel using a FCAW process.
4.1.D In all feasible positions, makes a multiple-pass groove weld on plain carbon steel using a FCAW process.
4.2.A Demonstrates method(s) of metal transfer used in the FCAW process.
4.2.B Demonstrates arc-control and oxidation-prevention processes used with FCAW.
4.2.A Performs root- and face-guided bend tests on a butt joint weld sample.
4.3.B Performs impact test on a butt joint weld sample.
4.4.A Performs magnetic particle tests on a butt joint weld sample.
4.4.B Performs dye penetrant test on a butt joint weld sample.

SAMPLE PERFORMANCE TASKS

- Using the FCAW process of welding complete an assigned project that incorporates design, fabrication, evaluation, and testing. Based on the instructor's decision, the project may incorporate welding processes other than FCAW.
- Comply with safety rules and regulations in the handling and operation of welding equipment.
- Practice FCAW welding for AWS tests on coupons. Test for quality and strength of welds.

INTEGRATION LINKAGES

Language Arts, Mathematics, Math for Technology, Applied Communications, Algebra, Geometry, Blueprint Reading, SkillsUSA Technical Championships, American Welding Society (AWS), Guide for Training and Qualification of Entry Level Welder, National Center for Construction Education Research (NCCER), Secretary's Commission on Achieving Necessary Skills (SCANS), *Professional Development Program*, SkillsUSA-VICA, Occupational Safety

and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA).

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STANDARD 5.0

Students will make fillet and groove welds on plain carbon steel in all positions using a short-circuit, spray transfer, or pulsed-arc Gas Metal Arc Welding (GMAW) process.

LEARNING EXPECTATIONS

The student will:

5.1 Make fillet and groove welds on plain carbon steel using a short-circuit, spray transfer, or pulsed-arc GMAW process in all feasible positions.
5.2 Comprehend the distinctive features of GMAW.
5.3 Conduct destructive tests such as guided bend tests and impact tests on samples of GMAW weldments.
5.4 Conduct non-destructive tests such as magnetic particle or dye penetrant on samples of GMAW weldments.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

5.1.A In all feasible positions, makes a fillet weld on plain carbon steel using a short-circuit and spray transfer GMAW process.
5.1.B In all feasible positions, makes a groove weld on plain carbon steel using a short-circuit and spray transfer GMAW process.
5.2.A Demonstrates the method(s) of metal transfer used in the GMAW process.
5.2.B Demonstrates the arc-control and oxidation-prevention processes used with GMAW.
5.3.A Performs root- and face-guided bend tests on a butt joint weld sample.
5.3.B Performs impact test on a butt joint weld sample.
5.4.A Performs magnetic particle tests on a butt joint weld sample.
5.4.B Performs dye penetrant test on a butt joint weld sample.

SAMPLE PERFORMANCE TASKS

- Using the GMAW process of welding complete an assigned project that incorporates design, fabrication, evaluation, and testing. Based on the instructor's decision, the project may incorporate welding processes other than GMAW.
- Comply with safety rules and regulations in the handling and operation of welding equipment.
- Practice GMAW welding for AWS tests on coupons. Test for quality and strength of welds.

INTEGRATION LINKAGES

Language Arts, Mathematics, Math for Technology, Applied Communications, Algebra, Geometry, Blueprint Reading, SkillsUSA Technical Championships, American Welding Society (AWS), Guide for Training and Qualification of Entry Level Welder, National Center for Construction Education Research (NCCER), Secretary's Commission on Achieving Necessary Skills (SCANS), *Professional Development Program*, SkillsUSA-VICA, Occupational Safety

and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA).

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STANDARD 6.0

Students will perform plasma arc cutting operations on carbon steel, stainless steel, and aluminum.

LEARNING EXPECTATIONS

The student will:

6.1 Perform manual straight, shaped, and beveled cutting operations on carbon steel, stainless steel, and aluminum using a plasma arc cutting process.

6.2 Perform machine-guided straight, shaped (where possible), and beveled cutting operations on plain carbon steel, stainless steel, and aluminum using a plasma arc cutting process.

6.3 Comprehend the methods of heat application and metal removal used in a plasma arc cutting process

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

6.1.A Accurately produces parts involving manual straight, shaped, and beveled cuts using the plasma arc cutting process on carbon steel.

6.1.B Accurately produces parts involving manual straight, shaped, and beveled cuts using the plasma arc cutting process on stainless steel.

6.1.C Accurately produces parts involving manual straight, shaped, and beveled cuts using the plasma arc cutting process on aluminum.

6.2.A Accurately produces parts involving machine-guided straight, shaped (where possible), and beveled cuts using the plasma arc cutting process on carbon steel.

6.2.B Accurately produces parts involving machine-guided straight, shaped (where possible), and beveled cuts using the plasma arc cutting process on stainless steel.

6.2.C Accurately produce sparts involving machine-guided straight, shaped (where possible), and beveled cuts using the plasma arc cutting process on aluminum.

6.3.A Demonstrates methods of heat generation and transfer used in a plasma arc cutting process.

6.3.B Demonstrates methods of metal removal used in a plasma arc cutting process.

SAMPLE PERFORMANCE TASKS

- Using the plasma arc cutting process of welding complete assigned project that incorporates design, fabrication, evaluation, and testing. Based on the instructor's decision, the projects must include welding on aluminum, stainless steel, and carbon steel.
- Comply with safety rules and regulations in the handling and operation of welding equipment.
- Practice plasma arc welding for AWS tests on coupons of carbon steel, stainless steel, and aluminum. Test for quality and strength of welds.

INTEGRATION LINKAGES

Language Arts, Mathematics, Math for Technology, Applied Communications, Algebra, Geometry, Blueprint Reading, SkillsUSA Technical Championships, American Welding Society (AWS), Guide for Training and Qualification of Entry Level Welder, National Center for Construction Education Research (NCCER), Secretary's Commission on Achieving Necessary Skills (SCANS), *Professional Development Program*, SkillsUSA-VICA, Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA)..

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STANDARD 7.0

Students will make fillet and groove welds on carbon steel, stainless steel, and aluminum in all positions, using a Gas Tungsten Arc Welding (GTAW) process.

LEARNING EXPECTATIONS

The student will:

7.1 Make fillet and groove welds on carbon steel, stainless steel, and aluminum using a GTAW process in all feasible positions.
7.2 Understand the distinctive features of GTAW.
7.3 Conduct destructive tests such as guided bend tests and impact tests on samples of GTAW weldments.
7.4 Conduct non-destructive tests such as magnetic particle or dye penetrant on samples of GTAW weldments.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

7.1.A In all feasible positions, makes a fillet weld on carbon steel, stainless steel, and aluminum using a GTAW process.
7.1.B In all feasible positions, makes a groove weld on carbon steel, stainless steel, and aluminum using a GTAW process.
7.2.A Explains arc-control and oxidation-prevention processes used with GTAW.
7.3.A Performs root- and face-guided bend tests on a butt joint weld sample.
7.3.B Performs impact test on a butt joint weld sample.
7.4.A Performs magnetic particle tests on a butt joint weld sample.
7.4.B Performs dye penetrant test on a butt joint weld sample.

SAMPLE PERFORMANCE TASKS

- Using the GTAW process of welding complete assigned projects that incorporates design, fabrication, evaluation, and testing. Based on the instructor's decision, projects may incorporate welding processes other than GTAW. Projects should include welding on carbon steel, stainless steel, and aluminum.
- Comply with safety rules and regulations in the handling and operation of welding equipment.
- Practice GTAW welding for AWS tests on coupons of carbon steel, stainless steel, and aluminum.. Test for quality and strength of welds.

INTEGRATION LINKAGES

Language Arts, Mathematics, Math for Technology, Applied Communications, Algebra, Geometry, Blueprint Reading, SkillsUSA Technical Championships, American Welding Society (AWS), Guide for Training and Qualification of Entry Level Welder, National Center for Construction Education Research (NCCER), Secretary's Commission on Achieving Necessary Skills (SCANS), *Professional Development Program*, SkillsUSA-VICA, Occupational Safety

and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA).

WELDING APPLICATIONS

SAMPLING OF AVAILABLE RESOURCES

- National Center for Construction Education and Research (NCCER), *Core Curriculum*. Prentice Hall, Upper Saddle River, NJ; ©2000. Also known as the "Wheels of Learning" materials.
- American Welding Society (AWS) Educators' Web site: http://www.aws.org/Educators/ (includes AWS Educator's Library online and downloadable *Engineering Your Future* Teacher's Guide.)
- American Welding Society (AWS), *Guide for Training and Qualification of Entry Level Welder*.
- Andrew D. Althouse, Carl H. Turnquist, William A. Bowditch and Kevin E. Bowditch. *Modern Welding.* Goodheart Willcox 2000. www.goodheartwillcox.com
- William A. Bowditch and Kevin E. Bowditch. *Welding Technology Fundamentals*. Goodheart Willcox 1997. www.goodheartwillcox.com
- James A. Ruck. *Welding Projects.* Goodheart Willcox 1999.
- *Introduction to Welding* Video Series. Glencoe 1998. www.glencoe.com